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EXAMINER	
KIM, DAVID S	
ART UNIT	**PAPER NUMBER**
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Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/993,849	GARRETT ET AL.	
	Examiner	Art Unit	
	David S. Kim	2633	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on 26 November 2001.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) 1-37 is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) 1-37 is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on 26 November 2001 is/are: a)☐ accepted or b)☒ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Drawings

1. The drawings are objected to under 37 CFR 1.83(a). The drawings must show every feature of the invention specified in the claims. Therefore, the features introduced by dependent **claims 7-10, 15-16, 24-29, and 32** must be shown or the feature(s) canceled from the claim(s). Also, the following features in independent **claims 33-35** must be shown or the features canceled from the claims. No new matter should be entered.

- (**claim 33**) one of the first and the second Mach-Zehnder type interferometers has an optical path length shorter than the optical path length of the other Mach-Zehnder type interferometer; and

a phase adjuster operable to adjust the phase of the series of optical pulses traveling between the Mach-Zehnder type interferometers so that the phase of the substantially sinusoidal electrical modulation signals applied to the Mach-Zehnder type interferometers is synchronized with the phase of the series of optical pulses input to the Mach-Zehnder type interferometers.

- (**claim 34**) a data-gate for modulating the series of optical pulses being output by the pulse generator to produce an output of optical data pulses;

a receiver for receiving the optical data pulses output from the data-gate; and

a transmission channel connecting the data gate to the receiver and along which the optical data pulses propagate from the data-gate to the receiver.

- (**claim 35**) one of the first and the second Mach-Zehnder type interferometers has an optical path length shorter than the optical path length of the other Mach-Zehnder type interferometer;

a phase adjuster operable to adjust the phase of the series of optical pulses traveling between the Mach-Zehnder type interferometers so that the phase of the substantially sinusoidal electrical modulation signals applied to the second Mach-Zehnder type interferometer is

synchronized with the phase of the series of optical pulses input to the second Mach-Zehnder type interferometer;

a data-gate for modulating the series of optical pulses being output by the pulse generator to produce an output of optical data pulses;

a receiver for receiving the optical data pulses output from the data-gate; and

a transmission channel connecting the data-gate to the receiver and along which the optical data pulses propagate from the data-gate to the receiver.

2. Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. The figure or figure number of an amended drawing should not be labeled as "amended." If a drawing figure is to be canceled, the appropriate figure must be removed from the replacement sheet, and where necessary, the remaining figures must be renumbered and appropriate changes made to the brief description of the several views of the drawings for consistency. Additional replacement sheets may be necessary to show the renumbering of the remaining figures. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either "Replacement Sheet" or "New Sheet" pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Specification

3. The abstract of the disclosure is objected to because of its undue length. Correction is required. See MPEP § 608.01(b).

Applicant is reminded of the proper language and format for an abstract of the disclosure.

The abstract should be in narrative form and generally limited to a single paragraph on a separate sheet within the range of **50 to 150** words. It is important that the abstract not exceed **150 words** in length since the space provided for the abstract on the computer tape used by the printer is limited. The form and legal phraseology often used in patent claims, such as "means" and "said," should be avoided. The abstract should describe the disclosure sufficiently to assist readers in deciding whether there is a need for consulting the full patent text for details.

The language should be clear and concise and should not repeat information given in the title. It should avoid using phrases which can be implied, such as, "The disclosure concerns," "The disclosure defined by this invention," "The disclosure describes," etc.

Claim Objections

4. **Claims 4 and 29** are objected to because of the following informalities:

In claim 4, line 1, "Mach-Zehnders" is used where -- Mach-Zehnder -- may be intended.

In claim 29, last 2 lines, "the other Mach-Zehnder type interferometer or others" is unclear and reads awkwardly.

Appropriate correction is required.

Claim Rejections - 35 USC § 112

5. The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

6. **Claims 4-5** are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the enablement requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention.

Note the following limitation of claims 4-5:

electro-optically biasing the *material propagating* the optical beams through at least one of the Mach-Zehnder type interferometers thereby changing a characteristic of the optical beams.

Generally, the *material* of Mach-Zehnder type interferometers does not *propagate* optical beams. However, optical beams do generally *propagate through* the material of Mach-Zehnder type interferometers. The specification appears to lack any disclosure that supports the material of Mach-Zehnder type interferometers propagating any optical beams. Accordingly, in view of the fact that such material itself does not generally propagate optical beams, one of ordinary skill in the art would have required undue experimentation to make and use the claimed invention. As a remedy, Examiner suggests adjusting the claim language so that the optical beams *propagate through* the material of the Mach-Zehnder type interferometers instead of the *material itself propagating* the optical beams.

7. **Claim 16** is rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the enablement requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention.

Note the following limitation of claim 16:

adjusting the phase of the series of optical pulses traveling between the Mach-Zehnder type interferometers *using* an electrical modulation signal delay line...so that the phase of the ...electrical...signals is synchronized with the phase of the...optical pulses.

Generally, an electrical modulation signal delay line is employed to adjust the phase of an *electrical* signal, not the phase of an *optical* signal/pulse. The specification appears to lack any disclosure that supports an *electrical* modulation signal delay line being used in adjusting the phase of the series of *optical* pulses. Rather, consider the corresponding portion of the specification:

> "For the two Mach-Zehnder type interferometers formed on the chip there is a time of flight that the optical beam takes to get from the output of one Mach-Zehnder type interferometer to the input of the other. One method for compensating for this effect is to try to build the electrical path so that it is exactly matched to offset the time of flight" (p. 17-18, bridging paragraph).

This portion of the specification appears to teach that an electrical modulation signal delay line is employed to adjust the phase of an *electrical* signal, not the phase of an *optical* signal/pulse.

Accordingly, in view of the fact that such an electrical modulation signal delay line does not generally adjust the phase of a series of *optical* pulses, one of ordinary skill in the art would have required undue experimentation to make and use the claimed invention. As a remedy, Examiner suggests adjusting the claim language so that claim 28 depends on claim 19 and separately introduces a new phase adjuster operable to adjust the phase of the *substantially sinusoidal electrical modulation signals*, wherein the phase adjuster is an electrical modulation signal delay line.

8. **Claim 28** is rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the enablement requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention.

Note the following limitation of parent claim 26:

a phase adjuster operable to adjust the phase of the series of *optical* pulses.

Note the following limitation of daughter claim 28:

wherein the phase adjuster is an *electrical* modulation signal delay line.

Generally, an electrical modulation signal delay line is employed to adjust the phase of an *electrical* signal, not the phase of an *optical* signal/pulse. The specification appears to lack any disclosure that supports an *electrical* modulation signal delay line being used in adjusting the phase of the series of *optical* pulses. Rather, consider the corresponding portion of the specification:

> "For the two Mach-Zehnder type interferometers formed on the chip there is a time of flight that the optical beam takes to get from the output of one Mach-Zehnder type interferometer to the input of the other. One method for compensating for this effect is

> to try to build the electrical path so that it is exactly matched to offset the time of flight" (p. 17-18, bridging paragraph).

This portion of the specification appears to teach that an electrical modulation signal delay line is employed to adjust the phase of an *electrical* signal, not the phase of an *optical* signal/pulse.

Accordingly, in view of the fact that such an electrical modulation signal delay line does not generally adjust the phase of a series of *optical* pulses, one of ordinary skill in the art would have required undue experimentation to make and use the claimed invention. As a remedy, Examiner suggests adjusting the claim language so that claim 28 depends on claim 19 and separately introduces a new phase adjuster operable to adjust the phase of the *substantially sinusoidal electrical modulation signals*, wherein the phase adjuster is an electrical modulation signal delay line.

9. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

10. **Claims 21-22** are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Note the following limitation in parent claim 20:

a signal splitter for splitting the substantially sinusoidal electrical modulation signal, according to a *fixed* split ratio.

Note the following limitation in daughter claims 21-22:

wherein the signal splitter is adapted to be controllable to so that splitting ratio of the substantially sinusoidal electrical modulation signal is *variable*.

Claims 21-22 appear to include a limitation that contradicts another limitation within the claims. In particular, the claim language discloses that the split ratio is both *fixed* and *variable*. Additionally, the specification discusses the invention as employing *either* a fixed split ratio *or* a

variable split ratio (p. 17, l. 17-22). This contradiction renders claims 21-22 as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. As a remedy, Examiner suggests adjustment to the claim language so that claims 21-22 depend on claim 19 and separately introduce a new signal splitter with a variable splitting ratio.

Claim Rejections - 35 USC § 102

11. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for a patent.
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

Shimizu et al.

12. **Claims 17-19, 26-27, and 36** are rejected under 35 U.S.C. 102(a) and (e) as being anticipated by Shimizu et al. (U.S. Patent No. 6,236,488 B1, hereinafter "Shimizu").

Regarding claim 17, Shimizu discloses:

A method of shaping an optical pulse, said method comprising:

inputting an optical beam (light from light source 26 in Fig. 17) into a first of a plurality of cascaded Mach-Zehnder type interferometers (3a and 3b in Fig. 17, 21-25, 27-29, 31, and 35-38):

applying a substantially sinusoidal electrical modulation signal (electrical input signal to 3a) to the first Mach-Zehnder type interferometer to generate a series of optical pulses having controllable chirp (it is known that chirp is a controllable characteristic of optical pulses); and

applying a substantially sinusoidal electrical modulation signal (electrical input signal to 3b) to the following cascaded Mach-Zehnder type interferometer to shape the series of optical pulses input to following Mach-Zehnder type interferometers to produce an output train of optical pulses (e.g., see pulses change from width W1 to W2 in Fig. 17) having a duty cycle that is dependent on the waveform of the electrical modulation signal being applied to at least one of the Mach-Zehnder type interferometers.

Regarding claim 18, Shimizu discloses:

A method of varying the duty cycle of an output train of optical pulses using

a first Mach-Zehnder type interferometer (3a in Fig. 17, 21-25, 27-29, 31, and 35-38) comprising an optical output and an electrical input, and

a second Mach-Zehnder type interferometer (3b in Fig. 17, 21-25, 27-29, 31, and 35-38) comprising an optical input and an electrical input,

the first and second Mach-Zehnder type interferometers being optically connected in series, with the optical output of the first Mach-Zehnder type interferometer being connected to the optical input of the second Mach-Zehnder type interferometer,

said method comprising:

applying a substantially sinusoidal electrical modulation signal (electrical input signal to 3a) to said electrical input of said first Mach-Zehnder type interferometer to generate a series of optical pulses having controllable chirp (it is known that chirp is a controllable characteristic of optical pulses); and

applying a substantially sinusoidal electrical modulation signal (electrical input signal to 3b) to the electrical input of the second Mach-Zehnder type interferometer to shape the series of

optical pulses that are input to the second Mach-Zehnder type interferometer to produce an output train of optical pulses (e.g., see pulses change from width W1 to W2 in Fig. 17) having a duty cycle that is dependent on the waveform of the substantially sinusoidal electrical modulation signals being applied to at least one of the first and the second Mach-Zehnder type interferometer.

Regarding claim 19, Shimizu discloses:

An optical pulse generator comprising:

at least two cascaded Mach-Zehnder type interferometers (3a and 3b in Fig. 17, 21-25, 27-29, 31, and 35-38) optically connected in series:

each Mach-Zehnder type interferometer comprising an optical input, an optical output, and an electrical input; the optical input of a successive Mach-Zehnder type interferometer being connected to the output of the immediately preceding Mach-Zehnder type interferometer in the series;

a signal generator (oscillator 5) which, in use, produces a substantially sinusoidal electrical modulation signal for application to the electrical input of each of the Mach-Zehnder type interferometers,

wherein the first Mach-Zehnder type interferometer is responsive to the substantially sinusoidal electrical modulation signal being applied to its electrical input, to generate a series of optical pulses (e.g., pulses with width W1 in Fig. 17) having controllable chirp (it is known that chirp is a controllable characteristic of optical pulses), and each successive Mach-Zehnder type interferometer is responsive to the substantially sinusoidal electrical modulation being applied to its electrical input, to shape the series of optical pulses that is input to the Mach-Zehnder type interferometer and produce an output train of optical pulses (e.g., see pulses change from width W1 to W2 in Fig. 17) having a duty cycle that is dependent on the waveform of the electrical modulation signal being applied to at least one of the Mach-Zehnder type interferometers.

Regarding claim 26, Shimizu discloses:

An optical pulse generator according to claim 19, further comprising:

a phase adjuster (optical delayer 24 in Fig. 24) operable to adjust the phase of the series of optical pulses traveling between the Mach-Zehnder type interferometers so that the phase of the substantially sinusoidal electrical modulation signals applied to the Mach-Zehnder type interferometers is synchronized with the phase of the series of optical pulses input to the Mach-Zehnder type interferometers.

Regarding claim 27, Shimizu discloses:

An optical pulse generator according to claim 26, wherein the phase adjuster is a phase-controllable waveguide (optical delayer 24 in Fig. 24).

Regarding claim 36, claim 36 is an apparatus claim that introduces limitations that correspond to the limitations introduced by apparatus claim 19. Therefore, the recited means in apparatus claim 19 read on the corresponding means in apparatus claim 36.

Fuerst et al.

13. **Claims 1-3, 17-19, 29, 31, and 36** are rejected under 35 U.S.C. 102(a) as being anticipated by Fuerst et al. (PCT International Application Publication No. WO 00/73847 A2, hereinafter "Fuerst," this action refers to the English translation provided in U.S. Patent No. 6,643,051 B1).

Regarding claim 1, Fuerst discloses:

A method of generating optical pulses with at least two cascaded Mach-Zehnder type interferometers (e.g., M1 and M2 in Fig. 1), each Mach-Zehnder type interferometer includes an optical input and a pair of interferometer arms, said method comprising:

feeding a continuous wave optical signal (beam from LM in Figures) into the optical input of a first of the MZIs;

modulating both arms (Figs. 7-8) of the first Mach-Zehnder type interferometer with a substantially sinusoidal electrical modulation signal (e.g., TS1 in Figures), whereby the first Mach-Zehnder type interferometer is caused to output a series of optical pulses each having controllable chirp (col. 3, l. 47-55);

feeding the optical output of the first Mach-Zehnder type interferometer into the optical input of the second MZI (optical input into M2);

modulating both arms (Figs. 7-8) of the second Mach-Zehnder type interferometer with a substantially sinusoidal electrical modulation signal (e.g., TS2 in Figures), whereby the second Mach-Zehnder type interferometer is caused to output a train of optical pulses (e.g., see pulses S3 in Fig. 17) having a duty cycle that is dependent on the waveform of the electrical modulation signal being applied to at least one of the Mach-Zehnder type interferometers,

wherein the frequency of the substantially sinusoidal electrical modulation signal applied to each Mach-Zehnder type interferometer is substantially the same (col. 2, l. 14).

Regarding claim 2, Fuerst discloses:

A method according to claim 1, wherein the substantially sinusoidal electrical modulation signals applied to each Mach-Zehnder type interferometer comprise substantially the same waveform (e.g., note the similarities between TS1 and TS2).

Regarding claim 3, Fuerst discloses:

A method according to claim 1, wherein both arms of the Mach-Zehnder type interferometers are modulated in anti-phase with a substantially sinusoidal electrical modulation signal, whereby the Mach-Zehnder type interferometers are caused to output a train of optical pulses having substantially zero frequency chirp (col. 3, l. 47-55).

Regarding claim 17, Fuerst discloses:

A method of shaping an optical pulse, said method comprising:

inputting an optical beam (beam from LM in Figures) into a first of a plurality of cascaded Mach-Zehnder type interferometers (e.g., M1 and M2 in Fig. 1):

applying a substantially sinusoidal electrical modulation signal (e.g., TS1 in Fig. 1) to the first Mach-Zehnder type interferometer to generate a series of optical pulses having controllable chirp (col. 3, l. 47-55); and

applying a substantially sinusoidal electrical modulation signal (e.g., TS2 in Fig. 1) to the following cascaded Mach-Zehnder type interferometer to shape the series of optical pulses input to following Mach-Zehnder type interferometers to produce an output train of optical pulses (e.g., see pulses change from S2 to S3 in Fig. 4) having a duty cycle that is dependent on the waveform of the electrical modulation signal being applied to at least one of the Mach-Zehnder type interferometers.

Regarding claim 18, Fuerst discloses:

A method of varying the duty cycle of an output train of optical pulses using

a first Mach-Zehnder type interferometer (e.g., M1 in Fig. 1) comprising an optical output and an electrical input, and

a second Mach-Zehnder type interferometer (e.g., M2 in Fig. 1) comprising an optical input and an electrical input,

the first and second Mach-Zehnder type interferometers being optically connected in series, with the optical output of the first Mach-Zehnder type interferometer being connected to the optical input of the second Mach-Zehnder type interferometer,

said method comprising:

applying a substantially sinusoidal electrical modulation signal (e.g., TS1 in Figures) to said electrical input of said first Mach-Zehnder type interferometer to generate a series of optical pulses having controllable chirp (col. 3, l. 47-55); and

applying a substantially sinusoidal electrical modulation signal (e.g., TS2 in Figures) to the electrical input of the second Mach-Zehnder type interferometer to shape the series of optical pulses that are input to the second Mach-Zehnder type interferometer to produce an output train of optical pulses (e.g., see pulses change from S2 to S3 in Fig. 4) having a duty cycle that is dependent on the waveform of the substantially sinusoidal electrical modulation signals being applied to at least one of the first and the second Mach-Zehnder type interferometer.

Regarding claim 19, Fuerst discloses:

An optical pulse generator comprising:

at least two cascaded Mach-Zehnder type interferometers (M1 and M2 in Fig. 1 or M1, M11, and M2 in Fig. 5) optically connected in series:

each Mach-Zehnder type interferometer comprising an optical input, an optical output, and an electrical input; the optical input of a successive Mach-Zehnder type interferometer being connected to the output of the immediately preceding Mach-Zehnder type interferometer in the series;

a signal generator (source of TS signals, not shown) which, in use, produces a substantially sinusoidal electrical modulation signal for application to the electrical input of each of the Mach-Zehnder type interferometers,

wherein the first Mach-Zehnder type interferometer is responsive to the substantially sinusoidal electrical modulation signal being applied to its electrical input, to generate a series of optical pulses (e.g., pulses S2 in Fig. 4) having controllable chirp (col. 3, l. 47-55), and each successive Mach-Zehnder type interferometer is responsive to the substantially sinusoidal electrical modulation being applied to its electrical input, to shape the series of optical pulses that is input to the Mach-Zehnder type interferometer and produce an output train of optical pulses (e.g., see pulses change from S2 to S3 in Fig. 4) having a duty cycle that is dependent on

the waveform of the electrical modulation signal being applied to at least one of the Mach-Zehnder type interferometers.

Regarding claim 29, Fuerst discloses:

An optical pulse generator according to claim 19, wherein at least one of the Mach-Zehnder type interferometers has an optical path length shorter than the optical path length of the other Mach-Zehnder type interferometer or others (col. 4, l. 17-24).

Regarding claim 31, Fuerst discloses:

An optical pulse generator according to claim 19, wherein at least one of the Mach-Zehnder type interferometers is adapted to modulate a phase of the optical pulses (note phase modulation in col. 3, l. 47-55).

Regarding claim 36, claim 36 is an apparatus claim that introduces limitations that correspond to the limitations introduced by apparatus claim 19. Therefore, the recited means in apparatus claim 19 read on the corresponding means in apparatus claim 36.

LaGasse et al.

14. **Claims 1-2, 17-19, 31, and 36** are rejected under 35 U.S.C. 102(e) as being anticipated by LaGasse et al. (PCT International Application Publication No. WO/03012535 A1, hereinafter "LaGasse").

Regarding claim 1, LaGasse discloses:

A method of generating optical pulses with at least two cascaded Mach-Zehnder type interferometers (e.g., 12 and 14 in Fig. 1), each Mach-Zehnder type interferometer includes an optical input and a pair of interferometer arms, said method comprising:

feeding a continuous wave optical signal (p. 6, l. 27-30) into the optical input of a first of the MZIs;

modulating both arms (Fig. 2, p. 8, l. 5-6) of the first Mach-Zehnder type interferometer with a substantially sinusoidal electrical modulation signal (e.g., signal 30), whereby the first Mach-Zehnder type interferometer is caused to output a series of optical pulses each having controllable chirp (it is known that chirp is a controllable characteristic of optical pulses);

feeding the optical output of the first Mach-Zehnder type interferometer into the optical input of the second MZI (optical input into 14);

modulating both arms (Fig. 2, p. 8, l. 5-6) of the second Mach-Zehnder type interferometer with a substantially sinusoidal electrical modulation signal (e.g., signal 32), whereby the second Mach-Zehnder type interferometer is caused to output a train of optical pulses (e.g., Fig. 5) having a duty cycle that is dependent on the waveform of the electrical modulation signal being applied to at least one of the Mach-Zehnder type interferometers,

wherein the frequency of the substantially sinusoidal electrical modulation signal applied to each Mach-Zehnder type interferometer is substantially the same (p. 6, l. 7-8).

Regarding claim 2, LaGasse discloses:

A method according to claim 1, wherein the substantially sinusoidal electrical modulation signals applied to each Mach-Zehnder type interferometer comprise substantially the same waveform (e.g., note the similarities between signals 30 and 32).

Regarding claim 17, LaGasse discloses:

A method of shaping an optical pulse, said method comprising:

inputting an optical beam (p. 6, l. 27-30) into a first of a plurality of cascaded Mach-Zehnder type interferometers (e.g., 12 and 14 in Fig. 1):

applying a substantially sinusoidal electrical modulation signal (e.g., signal 30) to the first Mach-Zehnder type interferometer to generate a series of optical pulses having controllable chirp (it is known that chirp is a controllable characteristic of optical pulses); and

applying a substantially sinusoidal electrical modulation signal (e.g., signal 32) to the following cascaded Mach-Zehnder type interferometer to shape the series of optical pulses input to following Mach-Zehnder type interferometers to produce an output train of optical pulses (e.g., Fig. 5) having a duty cycle that is dependent on the waveform of the electrical modulation signal being applied to at least one of the Mach-Zehnder type interferometers.

Regarding claim 18, LaGasse discloses:

A method of varying the duty cycle of an output train of optical pulses using

a first Mach-Zehnder type interferometer (e.g., 12 in Fig. 1) comprising an optical output and an electrical input, and

a second Mach-Zehnder type interferometer (e.g., 14 in Fig. 1) comprising an optical input and an electrical input,

the first and second Mach-Zehnder type interferometers being optically connected in series, with the optical output of the first Mach-Zehnder type interferometer being connected to the optical input of the second Mach-Zehnder type interferometer,

said method comprising:

applying a substantially sinusoidal electrical modulation signal (e.g., signal 30) to said electrical input of said first Mach-Zehnder type interferometer to generate a series of optical pulses having controllable chirp (it is known that chirp is a controllable characteristic of optical pulses); and

applying a substantially sinusoidal electrical modulation signal (e.g., signal 32) to the electrical input of the second Mach-Zehnder type interferometer to shape the series of optical pulses that are input to the second Mach-Zehnder type interferometer to produce an output train of optical pulses (e.g., Fig. 5) having a duty cycle that is dependent on the waveform of the substantially sinusoidal electrical modulation signals being applied to at least one of the first and the second Mach-Zehnder type interferometer.

Regarding claim 19, LaGasse discloses:

An optical pulse generator comprising:

at least two cascaded Mach-Zehnder type interferometers (e.g., 12 and 14 in Fig. 1) optically connected in series:

each Mach-Zehnder type interferometer comprising an optical input, an optical output, and an electrical input; the optical input of a successive Mach-Zehnder type interferometer being connected to the output of the immediately preceding Mach-Zehnder type interferometer in the series;

a signal generator (oscillator of p. 7, l. 11-12) which, in use, produces a substantially sinusoidal electrical modulation signal for application to the electrical input of each of the Mach-Zehnder type interferometers,

wherein the first Mach-Zehnder type interferometer is responsive to the substantially sinusoidal electrical modulation signal being applied to its electrical input, to generate a series of optical pulses (e.g., Fig. 4) having controllable chirp (it is known that chirp is a controllable characteristic of optical pulses), and each successive Mach-Zehnder type interferometer is responsive to the substantially sinusoidal electrical modulation being applied to its electrical input, to shape the series of optical pulses that is input to the Mach-Zehnder type interferometer and produce an output train of optical pulses (e.g., Fig. 5) having a duty cycle that is dependent on the waveform of the electrical modulation signal being applied to at least one of the Mach-Zehnder type interferometers.

Regarding claim 31, LaGasse discloses:

An optical pulse generator according to claim 19, wherein at least one of the Mach-Zehnder type interferometers is adapted to modulate a phase of the optical pulses (p. 8, l. 7-11).

Regarding claim 36, claim 36 is an apparatus claim that introduces limitations that correspond to the limitations introduced by apparatus claim 19. Therefore, the recited means in apparatus claim 19 read on the corresponding means in apparatus claim 36.

Claim Rejections - 35 USC § 103

15. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

16. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

Shimizu et al.

17. **Claims 1-2, 11-12, 15, 20, 31, and 34** are rejected under 35 U.S.C. 103(a) as being unpatentable over Shimizu.

Regarding claim 1, Shimizu discloses:

A method of generating optical pulses with at least two cascaded Mach-Zehnder type interferometers (3a and 3b in Fig. 17, 21-25, 27-29, 31, and 35-38), each Mach-Zehnder type interferometer includes an optical input and a pair of interferometer arms, said method comprising:

feeding an optical signal (output from light source 26) into the optical input of a first of the MZIs;

modulating the first Mach-Zehnder type interferometer with a substantially sinusoidal electrical modulation signal (sinusoidal output from oscillator 5), whereby the first Mach-Zehnder type interferometer is caused to output a series of optical pulses each having controllable chirp (it is known that chirp is a controllable characteristic of optical pulses);

feeding the optical output of the first Mach-Zehnder type interferometer into the optical input of the second MZI (optical input into 3b);

modulating the second Mach-Zehnder type interferometer with a substantially sinusoidal electrical modulation signal (sinusoidal output signal from oscillator 5), whereby the second Mach-Zehnder type interferometer is caused to output a train of optical pulses (e.g., see pulses of width W2 in Fig. 17) having a duty cycle that is dependent on the waveform of the electrical modulation signal being applied to at least one of the Mach-Zehnder type interferometers,

wherein the frequency of the substantially sinusoidal electrical modulation signal applied to each Mach-Zehnder type interferometer is substantially the same (signals from oscillator 5 to each MZI have substantially the same frequency).

Shimizu does not expressly disclose:

feeding a *continuous wave* optical signal into the optical input of a first of the MZIs;

modulating *both arms* of the first Mach-Zehnder type interferometer; and

modulating *both arms* of the second Mach-Zehnder type interferometer;

However, it is well known in the art the *continuous wave* optical signals is a standard and conventional output from light sources 26 of Shimizu (e.g., semiconductor laser diodes in col. 16, l. 6). Also, note the profile of the optical signal output from light source 26 in Fig. 17.

This profile matches that of a continuous wave optical signal. At the time the invention was made, it would have been obvious to a person of ordinary skill in the art to employ a *continuous wave* optical signal source as the light source 26 of Shimizu. One of ordinary skill in the art would have been motivated to do this since such sources are common and conventional, thus being quite likely to be inexpensive and familiar to one of ordinary skill in the art.

Also, it is well known in the art that modulating both arms of Mach-Zehnder type interferometers is a conventional and standard way of modulating MZIs. At the time the invention was made, it would have been obvious to a person of ordinary skill in the art to modulate both arms of the Mach-Zehnder type interferometers of Shimizu. One of ordinary skill in the art would have been motivated to do this such MZIs that operate in this fashion are common and conventional, thus being quite likely to be inexpensive and familiar to one of ordinary skill in the art.

Regarding claim 2, Shimizu discloses:

A method according to claim 1, wherein the substantially sinusoidal electrical modulation signals applied to each Mach-Zehnder type interferometer comprise substantially the same waveform (signals from oscillator 5 to each MZI have substantially the same waveform).

Regarding claim 11, Shimizu discloses:

A method according to claim 1, further comprising:

generating a substantially sinusoidal electrical modulation signal using a signal generator (oscillator 5);

splitting the substantially sinusoidal electrical modulation signal into at least two substantially sinusoidal electrical modulation signals using a power splitter (e.g., circuit node after oscillator 5 in Fig. 24); and

applying the respective substantially sinusoidal electrical modulation signals to the Mach-Zehnder type interferometers (e.g., inputs to 3a and 3b from oscillator 5 in Fig. 24).

Regarding claim 12, Shimizu does not expressly disclose:

A method according to claim 11, wherein the substantially sinusoidal electrical modulation signal is split according to a pre-determined fixed ratio.

However, it is known in the art that splitters, by default, split signals according to a pre-determined fixed ratio. One of ordinary skill in the art would recognize the splitting of Shimizu to be according to a pre-determined fixed ratio unless otherwise informed.

Regarding claim 15, Shimizu discloses:

A method according to claim 11, further comprising:

adjusting the phase of the series of optical pulses traveling between the Mach-Zehnder type interferometers using a phase-controllable waveguide (optical delayer 24 in Fig. 24) located between the Mach-Zehnder type interferometers so that the phase of the substantially sinusoidal electrical modulation signals applied to the Mach-Zehnder type interferometers is synchronized with the phase of the series of optical pulses input to the Mach-Zehnder type interferometers.

Regarding claim 20, Shimizu discloses:

An optical pulse generator according to claim 19, further comprising:

a signal splitter (e.g., circuit node after oscillator 5 in Fig. 24) for splitting the substantially sinusoidal electrical modulation signal into secondary substantially sinusoidal electrical modulation signals, each to be applied to one of the Mach-Zehnder type interferometers.

Shimizu does not expressly disclose:

splitting according to a fixed split ratio.

However, it is known in the art that splitters, by default, split signals according to a fixed split ratio. One of ordinary skill in the art would recognize the splitting of Shimizu to be according to a fixed split ratio unless otherwise informed.

Regarding claim 31, Shimizu does not expressly disclose:

An optical pulse generator according to claim 19, wherein at least one of the Mach-Zehnder type interferometers is adapted to modulate a phase of the optical pulses.

However, it is well known in the art Mach-Zehnder type interferometers operate by modulating the relative phase of optical signals that travel in one arm compared to the relative phase of optical signals that travel in another arm. One of ordinary skill in the art would recognize that at least one of the MZIs of Shimizu is adapted to modulate a phase of the optical pulses that propagate through this MZI.

Regarding claim 34, claim 34 is a system claim that corresponds largely to the apparatus claim 19. Therefore, the recited means in apparatus claim 19 read on the corresponding means in system claim 34. Claim 34 also includes limitations absent from claim 19. These limitations are:

a data-gate for modulating the series of optical pulses being output by the pulse generator to produce an output of optical data pulses;

a receiver for receiving the optical data pulses output from the data-gate; and

a transmission channel connecting the data gate to the receiver and along which the optical data pulses propagate from the data-gate to the receiver.

Shimizu does not expressly disclose these limitations. However, Examiner takes Official Notice that these limitations are extremely well known to be part of common transmission systems that employ pulse generators at the transmitting end. At the time the invention was made, it would have been obvious to a person of ordinary skill in the art to employ these

limitations since they constitute the simplest components required to implement a complete communication system when using a pulse generator.

More exactly, said data-gate is commonly known as an external modulator that passes a particular series of optical pulses according to a data input, or optical data pulses. In order to communicate this data input to another location, these optical pulses must travel through some medium, or transmission channel, from the pulse transmitter and data-gate at the transmitting end of the system to a receiving end of the system. In order to intelligibly receive the data inputted into the system, a receiver is required for receiving the optical data pulses.

18. **Claim 30** is rejected under 35 U.S.C. 103(a) as being unpatentable over Shimizu as applied to the claims above, and further in view of Nishimoto et al. (U.S. Patent No. 5,359,449, hereinafter "Nishimoto").

Regarding claim 30, Shimizu does not expressly disclose:

An optical pulse generator according to claim 19, further comprising:

a bias control circuit for maintaining bias alignment of at least one of the Mach-Zehnder type interferometers, and being electrically coupled to the electrical input of at least one of the Mach-Zehnder type interferometers, and being optically coupled to the optical output of at least one of the Mach-Zehnder type interferometers, said bias control circuit responsive to the function of the output train of optical pulses to apply a biasing electrical signal to at least one of the Mach-Zehnder type interferometers.

However, such bias control circuits for MZIs are well known in the art. Nishimoto teaches examples of such circuits (e.g., Figs. 14, 16, 18). At the time the invention was made, it would have been obvious to a person of ordinary skill in the art to implement a bias control circuit, such as one of the bias control circuits of Nishimoto, to maintain the bias alignment of at least one of the Mach-Zehnder type interferometers of Shimizu. One of ordinary skill in the art would have been motivated to do this since it is known that MZIs are susceptible to bias

operating point drift caused by temperature fluctuations and other ambient conditions (Nishimoto, col. 1, l. 67 – col. 2, l. 2). This drift leads to waveform distortion and extinction ratio deterioration (Nishimoto, col. 6, l. 39-44). Bias control circuits compensate for this drift to negate such negative effects.

19. **Claim 37** is rejected under 35 U.S.C. 103(a) as being unpatentable over Shimizu as applied to claim 36 above, and further in view of the APA.

Regarding claim 37, Shimizu does not expressly disclose:

An integrated chip according to claim 36, which is formed from gallium arsenide.

However, it is well known in the art that gallium arsenide is a common electro-optic material for apparatuses that comprise MZ interferometers. The APA teaches that lithium niobate and gallium arsenide are both examples of electro-optic materials (p. 1, l. 28-32). At the time the invention was made, it would have been obvious to a person of ordinary skill in the art to form the apparatus of Shimizu from gallium arsenide. One of ordinary skill in the art would have been motivated to do this since gallium arsenide is a common, suitable alternative (APA, p. 1, l. 28-32) to lithium niobate (mentioned in Shimizu, col. 16, l. 7-11), thus increasing design flexibility.

Fuerst et al.

20. **Claims 11-12, 20, 32, and 34** are rejected under 35 U.S.C. 103(a) as being unpatentable over Fuerst.

Regarding claim 11, Fuerst discloses:

A method according to claim 1, further comprising:

generating a substantially sinusoidal electrical modulation signal using a signal generator (source of electric signal of col. 4, l. 67);

splitting (not expressly disclosed but implied by electric wave to M1 and by electric wave to M2 in col. 5, l. 1-5) the substantially sinusoidal electrical modulation signal into at least two substantially sinusoidal electrical modulation signals using a power splitter (not expressly disclosed but implied by electric wave to M1 and by electric wave to M2 in col. 5, l. 1-5); and

applying the respective substantially sinusoidal electrical modulation signals to the Mach-Zehnder type interferometers (col. 5, l. 1-5).

Regarding claim 12, Fuerst does not expressly disclose:

A method according to claim 11, wherein the substantially sinusoidal electrical modulation signal is split according to a pre-determined fixed ratio.

However, it is known in the art that splitters, by default, split signals according to a pre-determined fixed ratio. One of ordinary skill in the art would recognize the splitting of Fuerst to be according to a pre-determined fixed ratio unless otherwise informed.

Regarding claim 20, Fuerst discloses:

An optical pulse generator according to claim 19, further comprising:

a signal splitter (not expressly disclosed but implied by electric wave to M1 and by electric wave to M2 in col. 5, l. 1-5) for splitting the substantially sinusoidal electrical modulation signal into secondary substantially sinusoidal electrical modulation signals, each to be applied to one of the Mach-Zehnder type interferometers.

Fuerst does not expressly disclose:

splitting according to a fixed split ratio.

However, it is known in the art that splitters, by default, split signals according to a fixed split ratio. One of ordinary skill in the art would recognize the splitting of Fuerst to be according to a fixed split ratio unless otherwise informed.

Regarding claim 32, Fuerst discloses:

An optical pulse generator according to claim 19, wherein the signal generator (source of at least one of the TS signals, not shown) is adapted to supply the substantially sinusoidal electrical modulation signals to the electrical input of some of the Mach-Zehnder type interferometers.

the optical pulse generator further comprises:

further signal generators (e.g., implied by source of TS11, not shown) for synchronously supplying, in use, substantially sinusoidal electrical modulation signals to the electrical inputs of the remainder of the Mach-Zehnder type interferometers.

Regarding claim 34, an obviousness argument is applied to address the limitations introduced by claim 34 in the treatment of claim 34 under Shimizu above. The same obviousness argument is similarly applied here.

21. **Claims 15, 26-27, 33, and 35** are rejected under 35 U.S.C. 103(a) as being unpatentable over Fuerst as applied to the claims above, and further in view of the Shimizu.

Regarding claim 15, Fuerst does not expressly disclose:

A method according to claim 11, further comprising:

adjusting the phase of the series of optical pulses traveling between the Mach-Zehnder type interferometers using a phase-controllable waveguide located between the Mach-Zehnder type interferometers so that the phase of the substantially sinusoidal electrical modulation signals applied to the Mach-Zehnder type interferometers is synchronized with the phase of the series of optical pulses input to the Mach-Zehnder type interferometers.

Rather, Fuerst teaches the synchronization of the phase of the electrical signals with the phase of the optical signals through an electronic phase shifter (PH in Fig. 6). However, multiple means for performing the equivalent synchronization are known. Another suitable means is shown by Shimizu, a phase-controllable waveguide located between MZIs (optical delayer 24 in Fig. 24). At the time the invention was made, it would have been obvious to a

person of ordinary skill in the art to employ such a phase-controllable waveguide in the method of Fuerst. One of ordinary skill in the art would have been motivated to do this since Shimizu shows that it is a suitable alternative to an electronic phase shifter (Fig. 24 as an alternative to Fig. 17).

Regarding claim 26, Fuerst in view of Shimizu discloses:

An optical pulse generator according to claim 19, further comprising:

a phase adjuster (Shimizu, optical delayer 24 in Fig. 24) operable to adjust the phase of the series of optical pulses traveling between the Mach-Zehnder type interferometers so that the phase of the substantially sinusoidal electrical modulation signals applied to the Mach-Zehnder type interferometers is synchronized with the phase of the series of optical pulses input to the Mach-Zehnder type interferometers.

Regarding claim 27, Fuerst in view of Shimizu discloses:

An optical pulse generator according to claim 26, wherein the phase adjuster is a phase-controllable waveguide (Shimizu, optical delayer 24 in Fig. 24).

Regarding claim 33, claim 33 is a system claim that corresponds largely to the apparatus claim 29. Therefore, the recited means in apparatus claim 29 read on the corresponding means in system claim 33. Claim 33 also includes limitations absent from claim 29. Fuerst in view of Shimizu also discloses these limitations:

a phase adjuster (Shimizu, optical delayer 24 in Fig. 24) operable to adjust the phase of the series of optical pulses traveling between the Mach-Zehnder type interferometers so that the phase of the substantially sinusoidal electrical modulation signals applied to the Mach-Zehnder type interferometers is synchronized with the phase of the series of optical pulses input to the Mach-Zehnder type interferometers.

Regarding claim 35, claim 35 is a system claim that corresponds largely to the apparatus claim 33. Therefore, the recited means in apparatus claim 33 read on the

corresponding means in system claim 35. Claim 35 also includes limitations absent from claim 33. These limitations are the same limitations that are introduced by claim 34. An obviousness argument is applied to address the limitations introduced by claim 34 in the treatment of claim 34 under Shimizu above. The same obviousness argument is similarly applied here.

22. **Claim 30** is rejected under 35 U.S.C. 103(a) as being unpatentable over Fuerst as applied to claim 19 above, and further in view of Nishimoto.

Regarding claim 30, Nishimoto is applied to address the limitations introduced by claim 30 in the treatment of claim 30 under Shimizu above. Nishimoto is similarly applied here.

23. **Claim 37** is rejected under 35 U.S.C. 103(a) as being unpatentable over Fuerst as applied to claim 36 above, and further in view of the APA.

Regarding claim 37, the APA is applied to address the limitations introduced by claim 37 in the treatment of claim 37 under Shimizu above. The APA is similarly applied here.

LaGasse et al.

24. **Claims 3 and 30** are rejected under 35 U.S.C. 103(a) as being unpatentable over LaGasse as applied to the claims above, and further in view of Nishimoto.

Regarding claim 3, LaGasse does not expressly disclose:

A method according to claim 1, wherein both arms of the Mach-Zehnder type interferometers are modulated in anti-phase with a substantially sinusoidal electrical modulation signal, whereby the Mach-Zehnder type interferometers are caused to output a train of optical pulses having substantially zero frequency chirp.

However, it is known that chirp is a controllable characteristic of optical signals. Nishimoto discusses modulation with MZIs to cause an optical output having substantially zero frequency chirp (col. 14, l. 7-14). At the time the invention was made, it would have been obvious to one of ordinary skill in the art to perform such modulation of Nishimoto. One of

ordinary skill in the art would have been motivated to do this since some communication situations favor no frequency chirp (Nishimoto, col. 1, l. 39-44).

Regarding claim 30, Nishimoto is applied to address the limitations introduced by claim 30 in the treatment of claim 30 under Shimizu above. Nishimoto is similarly applied here.

25. **Claims 6-14, 20-25, and 34** are rejected under 35 U.S.C. 103(a) as being unpatentable over LaGasse.

Regarding claims 6-10, claims 6-10 introduce limitations that vary the sets of bias voltages applied to the MZIs. LaGasse does not expressly teach the same sets of bias voltages introduced by claims 6-10. Rather, LaGasse generally teaches varying the sets of bias voltages to other values. At the time the invention was made, it would have been obvious to one of ordinary skill in the art to vary the sets of bias voltages to the MZIs to the values disclosed in claims 6-10. One of ordinary skill in the art would have been motivated to do this since the scope of LaGasse's teaching covers these values. That is, LaGasse teaches variations in the sets of bias voltages and drive amplitudes to achieve various desired extinction ratios and various pulse widths (p. 11, l. 4-11).

Regarding claim 11, LaGasse discloses:

A method according to claim 1, further comprising:

generating a substantially sinusoidal electrical modulation signal using a signal generator (oscillator of p. 7, l. 11-12);

splitting (not expressly disclosed but implied by drive signal 30 to modulator 12 and by drive signal 32 to modulator 14 in Fig. 1) the substantially sinusoidal electrical modulation signal into at least two substantially sinusoidal electrical modulation signals using a power splitter (not expressly disclosed but implied by drive signal 30 to modulator 12 and by drive signal 32 to modulator 14 in Fig. 1); and

applying the respective substantially sinusoidal electrical modulation signals to the Mach-Zehnder type interferometers.

Regarding claim 12, LaGasse does not expressly disclose:

A method according to claim 11, wherein the substantially sinusoidal electrical modulation signal is split according to a pre-determined fixed ratio.

However, it is known in the art that splitters, by default, split signals according to a pre-determined fixed ratio. One of ordinary skill in the art would recognize the splitting of LaGasse to be according to a pre-determined fixed ratio unless otherwise informed.

Regarding claim 13, LaGasse does not expressly disclose:

A method according to claim 11 , wherein the step of splitting comprises:

splitting the substantially sinusoidal electrical modulation signal in a variable ratio set by a split ratio controller associated with the power splitter.

However, split ratio controllers for power splitters are well known in the art. At the time the invention was made, it would have been obvious to one of ordinary skill in the art to employ such a controller in the method of LaGasse. One of ordinary skill in the art would have been motivated to do this to easily switch between the two disclosed embodiments of LaGasse (Fig. 1 and Fig. 7). That is, notice the differing amplitudes of the drive signals between the two embodiments and notice that LaGasse teaches varying the bias voltages and drive amplitudes to achieve a desired extinction ratio or a desired pulse width of the output optical pulses (p. 11, l. 4-11).

Regarding claim 14, LaGasse discloses:

A method according to claim 11, further comprising:

varying the ratio of splitting the substantially sinusoidal electrical modulation signals to produce substantially sinusoidal electrical modulation signals that vary one or more of: amplitude and phase of the optical beam, and optical pulses, as desired (p. 11, l. 4-11).

Regarding claim 20, LaGasse discloses:

An optical pulse generator according to claim 19, further comprising:

a signal splitter (not expressly disclosed but implied by drive signal 30 to modulator 12 and by drive signal 32 to modulator 14 in Fig. 1) for splitting the substantially sinusoidal electrical modulation signal into secondary substantially sinusoidal electrical modulation signals, each to be applied to one of the Mach-Zehnder type interferometers.

LaGasse does not expressly disclose:

splitting according to a fixed split ratio.

However, it is known in the art that splitters, by default, split signals according to a fixed split ratio. One of ordinary skill in the art would recognize the splitting of LaGasse to be according to a fixed split ratio unless otherwise informed.

Regarding claim 21, LaGasse discloses:

An optical pulse generator according to claim 20, wherein the signal splitter is adapted to be controllable so that the splitting ratio of the substantially sinusoidal electrical modulation signal is variable (p. 11, l. 4-11).

Regarding claim 22, LaGasse discloses:

An optical pulse generator according to claim 21, wherein the signal splitter is adapted to control the splitting ratio of the substantially sinusoidal electrical modulation signal with respect to amplitude (various drive signal amplitudes in p. 11, l. 4-11) of the substantially sinusoidal electrical modulation signal.

Regarding claims 23-25, claims 23-25 introduce limitations that vary the sets of bias voltages applied to the MZIs. LaGasse does not expressly teach the same sets of bias voltages introduced by claims 23-25. Rather, LaGasse generally teaches varying the sets of bias voltages to other values. At the time the invention was made, it would have been obvious to one of

ordinary skill in the art to vary the sets of bias voltages to the MZIs to the values disclosed in claims 23-25. One of ordinary skill in the art would have been motivated to do this since the scope of LaGasse's teaching covers these values. That is, LaGasse teaches variations in the sets of bias voltages and drive amplitudes to achieve various desired extinction ratios and various pulse widths (p. 11, l. 4-11).

Regarding claim 34, an obviousness argument is applied to address the limitations introduced by claim 34 in the treatment of claim 34 under Shimizu above. The same obviousness argument is similarly applied here.

26. **Claims 15 and 26-27** are rejected under 35 U.S.C. 103(a) as being unpatentable over LaGasse as applied to the claims above, and further in view of Fuerst and Shimizu.

Regarding claim 15, LaGasse does not expressly disclose:

A method according to claim 11, further comprising:

adjusting the phase of the series of optical pulses traveling between the Mach-Zehnder type interferometers using a phase-controllable waveguide located between the Mach-Zehnder type interferometers so that the phase of the substantially sinusoidal electrical modulation signals applied to the Mach-Zehnder type interferometers is synchronized with the phase of the series of optical pulses input to the Mach-Zehnder type interferometers.

Rather, LaGasse does not expressly address the issue of synchronization of the electrical modulation signals with the optical signals. However, notice that Fuerst teaches an extremely similar, if not the same, invention that does address the issue of synchronization (col. 5, l. 4-5). The similarities between the fundamental operating principles of LaGasse and Fuerst are strong enough that one of ordinary skill in the art would have recognized that practicing the invention of LaGasse also probably involves an issue of synchronization.

With this recognition, one of ordinary skill in the art would employ some known means for addressing this issue of synchronization. Fuerst and Shimizu is applied to address the

limitations introduced by claim 15 in the treatment of claim 15 under Fuerst in view of Shimizu above. Fuerst and Shimizu are similarly applied here.

Regarding claim 26, LaGasse in view of Fuerst and Shimizu discloses:

An optical pulse generator according to claim 19, further comprising:

a phase adjuster (Shimizu, optical delayer 24 in Fig. 24) operable to adjust the phase of the series of optical pulses traveling between the Mach-Zehnder type interferometers so that the phase of the substantially sinusoidal electrical modulation signals applied to the Mach-Zehnder type interferometers is synchronized with the phase of the series of optical pulses input to the Mach-Zehnder type interferometers.

Regarding claim 27, LaGasse in view of Fuerst and Shimizu discloses:

An optical pulse generator according to claim 26, wherein the phase adjuster is a phase-controllable waveguide (Shimizu, optical delayer 24 in Fig. 24).

27. **Claims 29** is rejected under 35 U.S.C. 103(a) as being unpatentable over LaGasse as applied to the claims above, and further in view of Fuerst.

Regarding claim 29, LaGasse does not expressly disclose:

An optical pulse generator according to claim 19, wherein at least one of the Mach-Zehnder type interferometers has an optical path length shorter than the optical path length of the other Mach-Zehnder type interferometer or others.

However, notice that Fuerst teaches an extremely similar, if not the same, invention that does include MZIs with differing optical path lengths (col. 4, l. 17-24). At the time the invention was made, it would have been obvious to one of ordinary skill in the art to employ such differing path lengths in the apparatus of LaGasse. One of ordinary skill in the art would have been motivated to do this since this teaching provides another suitable means to provide differing drive amplitudes to the apparatus of LaGasse (LaGasse, p. 11, l. 4-11), increasing design flexibility.

28. **Claims 33 and 35** are rejected under 35 U.S.C. 103(a) as being unpatentable over LaGasse in view of Fuerst as applied to claim 29 above, and further in view of Shimizu.

Regarding claim 33, claim 33 is a system claim that corresponds largely to the apparatus claim 29. Therefore, the recited means in apparatus claim 29 read on the corresponding means in system claim 33. Claim 33 also includes limitations absent from claim 29. These limitations are:

a phase adjuster operable to adjust the phase of the series of optical pulses traveling between the Mach-Zehnder type interferometers so that the phase of the substantially sinusoidal electrical modulation signals applied to the Mach-Zehnder type interferometers is synchronized with the phase of the series of optical pulses input to the Mach-Zehnder type interferometers.

LaGasse in view of Fuerst does not expressly disclose these limitations. However, notice that these limitations are also introduced by claim 15. Fuerst and Shimizu is applied to address these limitations introduced by claim 15 in the treatment of claim 15 under LaGasse in view of Fuerst and Shimizu above. Fuerst and Shimizu are similarly applied here.

Regarding claim 35, claim 35 is a system claim that corresponds largely to the apparatus claim 33. Therefore, the recited means in apparatus claim 33 read on the corresponding means in system claim 35. Claim 35 also includes limitations absent from claim 33. These limitations are the same limitations that are introduced by claim 34. An obviousness argument is applied to address the limitations introduced by claim 34 in the treatment of claim 34 under Shimizu above. The same obviousness argument is similarly applied here.

29. **Claim 37** is rejected under 35 U.S.C. 103(a) as being unpatentable over LaGasse as applied to claim 36 above, and further in view of the APA.

Regarding claim 37, the APA is applied to address the limitations introduced by claim 37 in the treatment of claim 37 under Shimizu above. The APA is similarly applied here.

Conclusion

30. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Fuerst et al. (PCT International Application Publication No. WO 00/73847 A3) is cited to show the international search report for Fuerst et al. (PCT International Application Publication No. WO 00/73847 A2), which was applied to address the merits of Applicant's claims.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to David S. Kim whose telephone number is 571-272-3033. The examiner can normally be reached on Mon.-Fri. 9 AM to 5 PM (EST).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Jason Chan can be reached on 571-272-3022. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

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